Small Business Innovation Research/Small Business Tech Transfer

Fast Responding PSP for Rotorcraft Aerodynamic Investigations, Phase I

Completed Technology Project (2009 - 2009)

Project Introduction

The proposed work focuses on implementing fast-response pressure-sensitive paint and Surface Stress Sensitive Films for measurements of unsteady pressure and skin friction in rotorcraft applications. Significant rotorcraft problems such as dynamic stall, rotor blade loads in forward flight, and blade-vortex interaction all have significant unsteady pressure oscillations that must be resolved in order to understand the underlying physics. Often these unsteady pressures are difficult to resolve in the rotating frame due to difficult installation of pressure transducers, and data is available only at discrete points. Pressure-sensitive paint formulations have been developed to provide surface pressure information in situations such as this, but conventional PSP formulations have slow response times. Conventional skin friction measurements, for example oil flow, do not offer significant frequency response. In order to improve the frequency response characteristics of PSP, sprayed porous paint binders have been developed for measurement of unsteady pressures. Fast-responding Surface Stress Sensitive Films provide both quantitative skin friction and qualitative flow visualization measurements. These techniques can provide high-spatial-resolution, time-resolved pressure and skin friction information that will provide unparalleled insight into the physical mechanisms driving certain rotorcraft problems. Both of these techniques will be demonstrated in Ohio State's unique 6"x22" transonic wind tunnel, where an airfoil may be tested for dynamic stall simulation in compressible flow. Successful demonstration of fast-responding PSP and S3F on a dynamic stall test in the 6"x22" tunnel will serve as a proof of concept that will allow transition of the technologies into larger-scale wind tunnels at NASA and elsewhere.

Anticipated Benefits

Potential NASA Commercial Applications: Non NASA commercial applications of this technology are mostly in the bio-medical field where measurements of skin friction are essential to the design of artificial implants to minimize the occurrence of clotting. Also with respect to contact force measurements, ISSI has developed a sensor based on the S3F technology which is being used to study the effect of shear and on diabetic ulceration in feet. In conjunction with these proof of concept tests, ISSI has recently developed a commercial Pressure Sensitive Paint system. The components of the skin friction technology have been developed to be compatible with this commercially deployed system and therefore, extension of these systems to include skin friction measurements is offered as a system upgrade. Along with internal marketing efforts of ISSI, TekMark has been retained as an external contractor to assist ISSI with marketing of the PSP/Skin Friction system. Over the past 12 months, eight complete systems and several components have been sold with total revenue of over $500,000.

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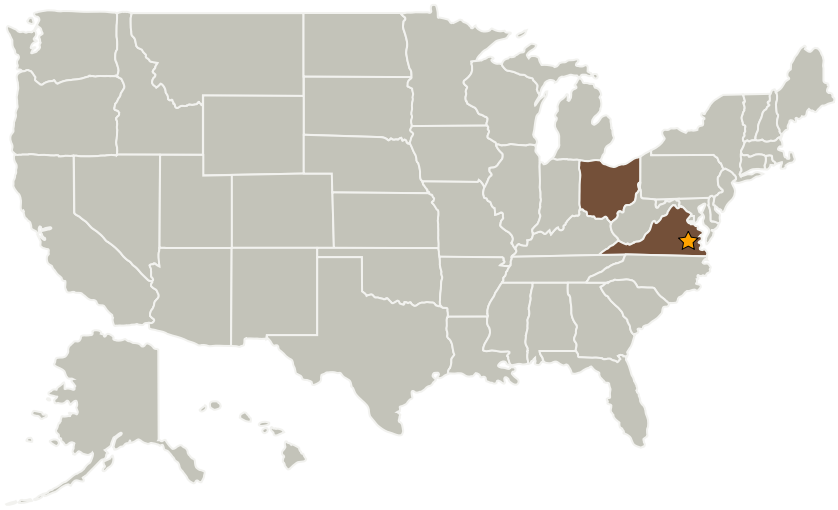
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Innovative Scientific Solutions, Inc.	Supporting Organization	Industry	Dayton, Ohio

Primary U.S. Work Locations	
Ohio	Virginia

Project Transitions

January 2009: Project Start

July 2009: Closed out

Closeout Summary: Fast Responding PSP for Rotorcraft Aerodynamic Investigations, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

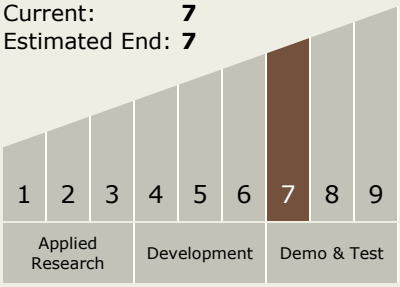
Carlos Torrez

Principal Investigator:

Jim Crafton

Technology Maturity (TRL)

Start: **7**
Current: **7**
Estimated End: **7**



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Completed Technology Project (2009 - 2009)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.1 Aerodynamics